

## **REMARKS**

### **I. Restriction Requirement**

Pursuant to a Response to Restriction Requirement mailed July 11, 2005, Applicants respectfully elected claims 15-30, without traverse, and withdrew claims 1-14, without prejudice.

### **II. Claim Rejections under 35 U.S.C. §112**

Dependent claim 23 was rejected by the Examiner as being indefinite for including the word "may" and has been amended to delete the word "may".

### **III. Claim Rejections under 35 U.S.C. §103(a)**

In the subject Office Action, claims 15-16, 18-22, 24-28 and 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Vogel et al in view of Lee et al ("first combination of references"). Dependent claims 18 and 30 (now part of independent claims 15 and 24, respectively) were rejected with this first combination of references. Dependent claims 25-27 and 16, 19, 22 and 28 were rejected with this first combination of references in combination with the level of ordinary skill in the art (original dependent claims 16 and 28 are now part of independent claims 15 and 24, respectively). Additionally, dependent claims 17 and 29 were rejected with the first combination of references in combination with Sheu et al.

In an alternative set of rejections, claims 15-16, 18-19, 21-22, 24-28 and 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over the '957 reference in view of Gektin et al ("second combination of references"). Dependent claims 18 and 30 were rejected with this second combination of references in combination with the Examiner stating that the thermal interface was "known to artisans in the art". Dependent claims 16, 19, 22, and 28 were rejected with the second combination of references in combination with the ordinary skill in the art. Dependent claims 17 and 19 were rejected with the second combination of references in combination with Sheu et al.

### **A. Overview of Amendments**

Amended independent claim 15 now includes the recitations of original dependent claims 16 and 18. Amended independent claim 24 now includes the recitations of original dependent claims 28 and 30. In addition, both independent claims 15 and 24 have been amended to recite a “compliant relationship” between the bumpless die and the heat spreader lid. Original dependent claims 16 and 28 have been cancelled and original dependent claims 18, 23, and 30 have been amended.

### **B. First Argument – thin wafer**

With respect to the rejections of independent claims 15 and 24 based upon the first and the second combination of references, independent claims 15 and 24 have been amended to define a thin die “having a thickness no greater than 50 microns” (previously recited in original dependent claims 16 and 28). The inventions in claims 15 and 24 define an integrated circuit package (“apparatus”) using such a thin die to contribute to improved thermal performance of the package and to reduced stresses in the package, as described in detail in the subject application.

With respect to independent claims 15 and 24, as described in the Background Section, a prior art bumped wafer providing bumped dice may only be thinned to a thickness of about 125 microns without using an undesirable special bump protection adhesive, because the presence of the solder bumps on the wafer that imprint on the wafer without the protection adhesive. Additionally, at 125 micron thickness or less, the wafer may not be able to support its own weight. The claimed “bumpless die” of independent claims 15 and 24 (and therefore a bumpless wafer from which the bumpless die is obtained) provides for the thickness of the die to be reduced to 50 microns or less, because the solder bumps are not on the wafer when the wafer is being thinned. Hence, neither the Vogel reference or the ‘957 reference, nor any of the other references disclose a bumpless die having a thickness no greater than 50 microns.

### **C. Second Argument – hard solder**

With respect to the rejections of independent claims 15 and 24 based upon the first and the second combination of references, independent claims 15 and 24 have been amended to recite that “a thermal interface material in the form of a hard solder interposed between the die and the heat spreader lid to bond the die to the heat spreader lid”. As described in paragraph 19 of the application, the hard solder allows the thermal interface material to be relatively thin, so that this thinness also may contribute to the improved thermal performance of the apparatus (IC package). Hence, the thermal performance of this thermal interface complements the thermal performance of the thin die. None of the references cited by the Examiner disclose the use of a hard solder.

### **D. Third Argument – Product by Process**

With respect to the rejections of independent claims 15 and 24 based upon the first and the second combination of references, the Examiner, based upon MPEP sections 2112.01 and 2113, has taken the position that the following claim limitations in independent claims 15 and 24 are not material to patentability because they are product-by-process limitations: “to form a module”, “the module being mounted to the die carrier” and “when the module is mounted to the die carrier”. Applicants concede that the language “when the module is mounted to the die carrier” may infer a product-by-process limitation; however, the other two clauses merely recite structural relationships between claim elements.

With respect to MPEP section 2113, Applicants would like to draw the Examiner’s attention to the following paragraph:

“The structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art, especially where the product can only be defined by the process steps by which the product is made, or where the manufacturing process steps would be expected to impart distinctive structural characteristics to the final product. See, e.g., *In re Garnero*, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979) (holding “interbonded by interfusion” to limit structure of the claimed composite and noting that terms such as “welded,” “intermixed,” “ground in place,” “press fitted,” and “etched” are capable of construction as structural limitations.)”

The term “module”, which is the combination of the die and the heat spreader lid, forms a single unit wherein “The IHS lid 36 may force the thinned die 32, which is firmly bonded, to be compliant with it, and thus the die 32 may have an effective CTE as high as 15 ppm/C (paragraph 21 of subject application)”. The formation of this single unit (module) with a compliant, bumpless die, prior to mounting the module to the die carrier, allows for incorporation of the claimed thin die (50 micron thickness or less) that contributes to the improved thermal performance and stress reduction, as now clarified by defining a “compliant relationship” in independent claims 15 and 24.

Referring to the language in the above paragraph of MPEP section 2113, the manufacturing process step (“the module being mounted to die carrier with the solder bumps being bonded to the bonding pads when the module is mounted to the die carrier”) would be expected to impart distinctive structural characteristics (the bumpless die being made compliant with the IHS lid prior to mounting on the lid so as to allow the incorporation of the thin die) to the final product (“apparatus”). None of the references disclose the forming of this single unit (module) prior to mounting the die and the lid onto the die carrier.

#### **E. Fourth Argument – additional recitations in dependent claims**

With respect to the above described thinness of the thermal interface material allowed by use of a hard solder, it should be noted that dependent claim 19 recites that the thermal interface material has a thickness no greater than 20 microns. Additionally, amended dependent claims 18 and 30 recite two examples of a hard solder, which have antecedent basis in the specification in paragraph 19 of the subject application.

Additionally, dependent claim 20 basically claims the absence of an underfill material (“empty space”), which is typically used in the prior art to reduce stress. With less stress due to the thin die, there may be less need for the underfill material, as described in the application.

#### IV. Conclusion

Applicants have traversed the Examiner's rejection of independent claims 15 and 24 based upon the foregoing amendments and arguments. Dependent claims 17-23 should be allowable based upon being dependent from independent claim 15. Dependent claims 25-27 and 29-30 should be allowable based upon being dependent from independent claim 24. Dependent claims 16 and 28 have been cancelled.


Applicants submit claims 15, 17-27, 29-30 are in condition of allowance. Early issuance of Notice of Allowance is respectfully requested.

The Commissioner is hereby authorized to charge shortages or credit overpayments to Deposit Account No. 500393.

Respectfully submitted,

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